Zircon of the No. 782 deposit from the Great Xing'an Range in NE China: Implications for Nb-REE-Zr mineralization

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The Nb-REE-Zr mineralization in the No. 782 deposit of NE China developed in a fine-grained porphyry (porphyry), which is hosted in a coarse-grained granite (granite) that dominates the study area. Zircon is the only Zr-bearing mineral in both the porphyry and the granite. In contrast to the granite that hosts only magmatic zircon, both magmatic (type I) and deuteric (type II) zircon is present in the porphyry. Most type I zircon occurs as individual crystals that are hosted mainly in interstitial quartz, with evident oscillatory zoning. Type II zircon commonly occurs as aggregates rather than individual crystals and exhibits vague zoning. Distribution of the type II zircon in the porphyry is heterogeneous, with great abundance in places where there are substantial albitization and snowball quartz crystals. Textural and chemical features of the type II zircon and of the associated albite and snowball quartz crystals suggest that all these minerals are metasomatic. Nb is hosted mainly by fergusonite-(Y) and, REE by fergusonite-(Y) and to a lesser extent, by bastnäsite-(Ce) and parisite-(Ce), where parisite-(Ce) occurs as a replacement of bastnäsite-(Ce). The Nb-REE mineralization occurs either as a replacement of the type II zircon or in chlorite-/quartz-dominant veinlets that postdated both the type I and the type II zircon. Most type I zircon in the porphyry was not replaced, possibly because the type I crystals were encased earlier by other magmatic minerals. The chronological and oxygen isotopic data of zircon suggest that the porphyry (453.8 ± 3.1 Ma) is younger than the granite (487.0 ± 4.0 Ma), and that the two granitic phases derived from different magma chambers. The subtle age difference between type I and type II zircon cannot be shown in our SHRIMP U-Pb data. The medium from which type II zircon precipitated is likely an internally-derived hydrosilicate liquid (HSL) that lies compositionally in between a silicate melt and a hydrothermal fluid during the magmatic-hydrothermal transition. The Nb-REE mineralization, on the other hand, originated from an aqueous fluid that was constrained to the porphyry.